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Original Communication

Sexual dimorphism of mandibular angle in a Lebanese sample

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ABSTRACT

Sexual dimorphism represents a group of morphologic characteristics that differentiate males from females. Craniofacial morphology and more specifically the mandibular angle have been evaluated for their interest in orthodontic, anthropologic and forensic applications. Currently, limited data are available relative to the significance of the mandibular angle in sex determination in various populations. The objective of this preliminary study is to evaluate the significance of the mandibular angle in sex determination in a sample of Lebanese young individuals.

Lateral cephalometric radiographs were obtained from 83 young individuals (40 males and 43 females) aged between 17 and 26 years. No statistically significant differences were detected between both genders relative to the mean values of A1, A2 and A3 measured for each individual using the ramus plane intersected with the mandibular planes of Downs, Sassouni and Steiner, respectively.

This study demonstrated no significant difference of the mandibular angle in sex determination in the young Lebanese population. Further investigations with a larger sample size and a strongly established Lebanese background should be conducted to test the applicability of the mandibular angle sexual dimorphism.

1. Introduction

Many studies have been conducted on forensic anthropology taking several cephalo-facial characteristics.[1–5] Various morphologic characteristics that differentiate a male from a female are referred to as sexual dimorphism. Dimorphic traits in the human skeleton of various populations are of utmost importance in sex determination and identification of growth patterns for orthodontic, anthropologic and forensic purposes and have mainly been based on the skull and pelvis bones.[6] Craniofacial morphology including specific characteristics such as dento-alveolar height,[7] Facial Height Ratio (FHR) of Jarabak,[8] cephalometric measurements such as SNA and SNB[9] and cranial base angle,[10] cranio-dento-facial width and morphology,[11] and length of the anterior cranial base[12] have been evaluated in different ethnic groups.[9–12]

Other dimorphic elements have been reported relative to the mandibular bone such as the mandibular or gonial angle, the ramus length, the bigonial width, and the bicondylar width.[13–16] The morphologic characteristics of the mandible have been mainly studied using cephalometric data or image analysis along with data processing programs. Recently, the elliptical Fourier analysis of the mandibular outline[17] provided increasing accuracy of sex identification based on the human mandible.[18]

The mandibular angle is of particular interest for both orthodontics,[19] and forensic medicine researchers whose work is based on ethnic groups. However, the significance of the mandibular angle as a sexual dimorphic parameter has been less investigated.[11,13]

Currently, limited data are available to determine if the sexual dimorphism of the mandibular angle can be demonstrated in different ethnic and racial groups. Research studies and anthropological findings indicate not only did each racial group have its own standards but within the same race, each subgroup had its own standards.

As no Lebanese data are yet available, the objectives of this preliminary study are to evaluate the differences of the mandibular angle between males and females in a sample of young Lebanese using three of mandibular angle measurements. This will allow

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drawing preliminary conclusions as to the significance of the mandibular angle in sex determination in this population.

2. Methods

2.1. Study sample

The studied population included 83 young healthy Lebanese (40 males and 43 females) aged between 17 and 26 years from different Lebanese regions. Selection of participants was based on the following inclusion criteria:

(1) Lebanese with both parents and grandparents of Lebanese origin on both sides.
(2) Normal growth pattern with normal height and weight for age.
(3) Normal occlusion and balanced symmetrical facial proportions (from a subjective assessment).
(4) Presence of all teeth in all cases except for the third molars.

Patients with history of previous facial trauma and orthognatic or plastic facial surgery were excluded from the study. Lateral cephalometric radiographs were obtained for all 83 individuals using the same radiographic apparatus (Planmeca, Helsinki, Finland) and standardized mandibular orientation and exposure parameters. Each participant was in standard position with the teeth in centric position and lips relaxed.

The following cephalometric landmarks were traced by a single calibrated blinded orthodontist using an orthodontist ruler (Dentaurum, Germany) with an accuracy of 1 min (Fig. 1).

- Me (chin): The most inferior point of the outline of the mandibular symphysis in the midsagittal plan;
- Gn (Gnathion): The center of the inferior contour of the chin;
- Co (Condylion): The most posterior and superior point on the contour of the mandibular condyle;
- Go (Gonion): The point of intersection of the contour and the bisector of the mandibular angle formed by the tangents along the basilary corpus and posterior ramus;
- préGo: The most inferior point of the ramus;
- Pr (Co–Go): Mandibular ramus plane represented by a tangent along the posterior aspect of the ramus and passing through condyle;
- Pm: Mandibular plane which was traced according to three techniques (Downs, Steiner and Sassouni):
  - Pm of Downs: Represented by the préGo–Me plane;
  - Pm of Steiner: Traced as the Go–Gn plane;
  - Pm of Sassouni: Represented by the Go–Me plane.

Three values of the mandibular angle (A1, A2 and A3) were subsequently measured for each individual using the ramus plane intersected with the mandibular planes of Downs, Sassouni and Steiner, respectively[20,24], (Figs. 2–4).

2.2. Statistical analysis

The student *t*-test was applied to evaluate the differences of the mean values of A1, A2 and A3 between males and females. In addition, the differences between A1, A2 and A3 were assessed in each sex group using the *t*-test. The statistical significance level was set at $P < 0.01$.

3. Results

Table 1 summarizes the mean values of A1, A2 and A3 among men and women of the study sample. No statistically significant differences could be demonstrated between males and females relative to the mean values and standard deviation of all three mandibular angles. The three mandibular angles for females were slightly smaller than those of males.

Further more, the mean values of A3 were significantly smaller than those A2 among males and females separately. Similarly, the mean values of A2 were significantly less than those of A1 in both genders. In addition, A1 values were significantly less than those of A3 ($P < 0.01$) (see Table 2).

As a result, the values of A1, A2 and A3 were significantly different with A1 > A2 > A3 with $P < 0.01$ in both genders independently.

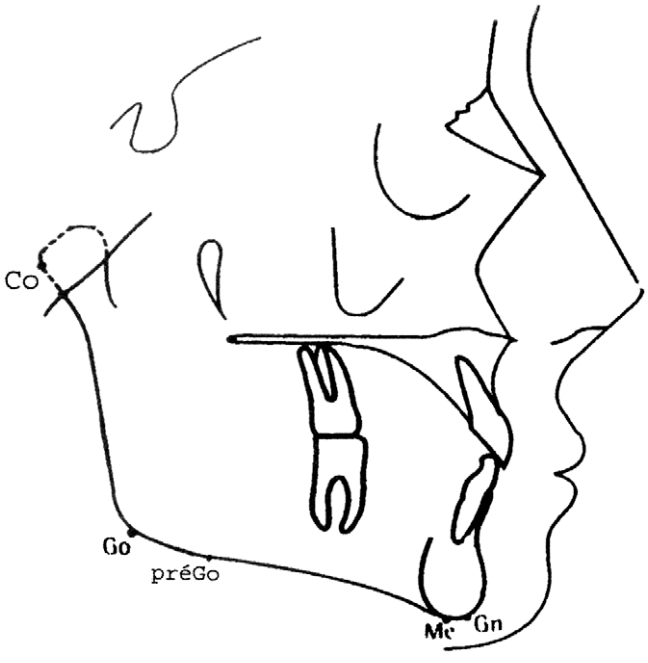

Fig. 1. Landmarks used for the cephalometric analysis: **Co**, **Go**, **Me**, **Gn**, **préGo**.

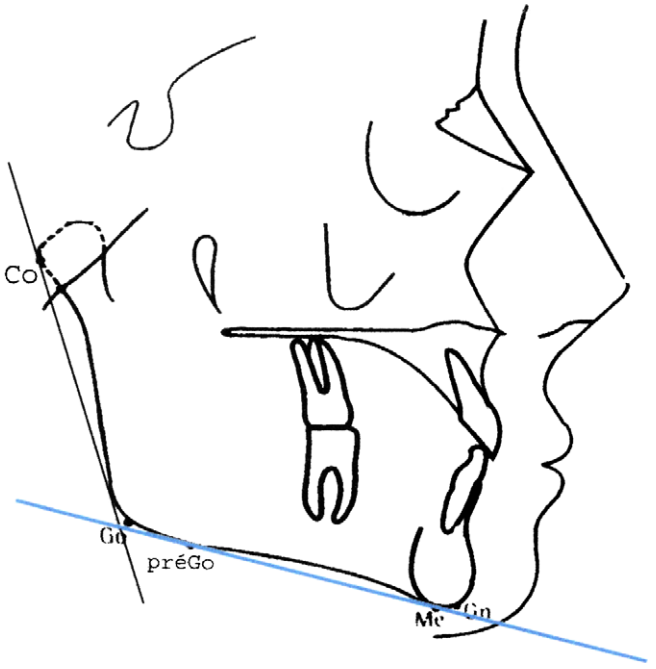

Fig. 2. A1 corresponds to the intersection between the mandibular plane of Downs's **préGo–Me** and the **Pr** plane (ramus plane).

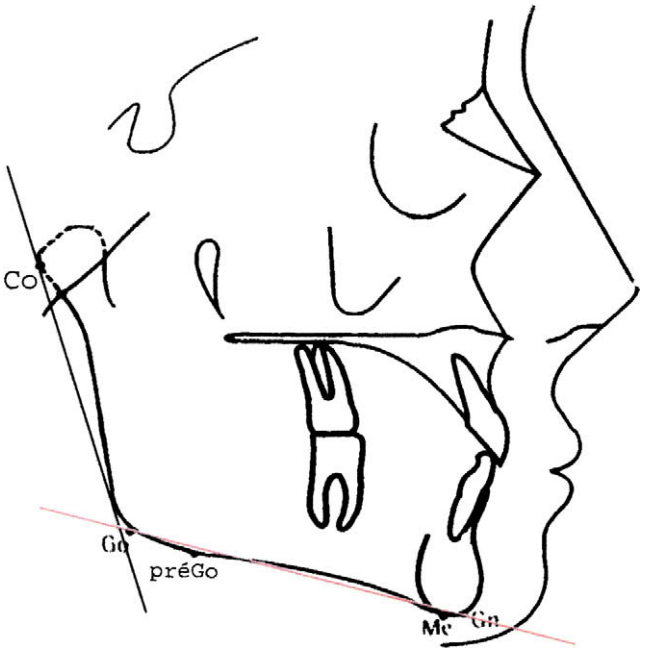

Fig. 3. A3 is formed between the mandibular plane of Steiner **Go–Gn** and the **Pr** plane (ramus plane).

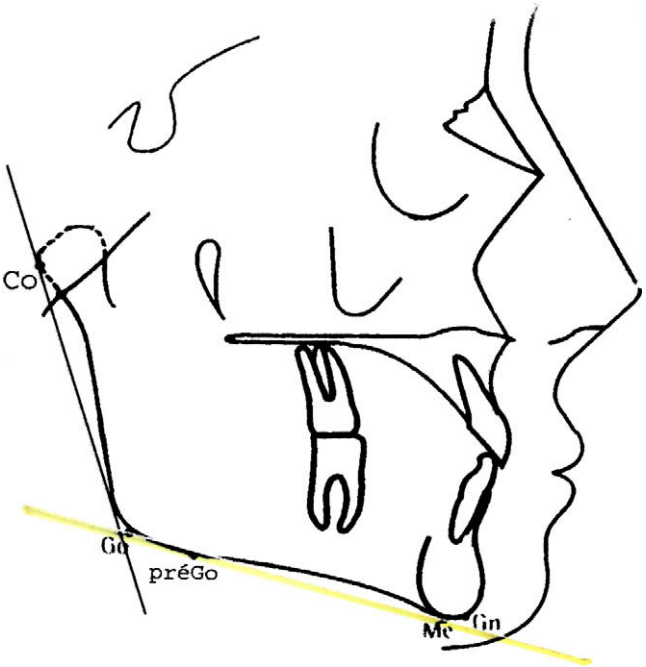

Fig. 4. A2 is formed between the mandibular plane of Sassouni **Go–Me** and the **Pr** plane (ramus plane).

Table 1
Comparison of the mandibular angle values in males and females young Lebanese

Angles	Men (n = 40)	Women (n = 43)	P-values
	Mean (SD)	Mean (SD)	
A1	121.76 (6.59)	121.08 (6.55)	0.639202
A2	119.94 (6.38)	118.53 (6.65)	0.335707
A3	117.18 (6.07)	115.81 (6.94)	0.341855

SD = standard deviation.
P < 0.01 was considered significant.

Table 2
Comparison between the three values of the mandibular angle independently in male group and female group

		A1 = A2	A2 = A3	A1 = A3
Men	Mean of differences	1.81	2.76	4.57
	SE	1.72	1.09	2.00
	P	$6.65E^{-08}$	$1.22E^{-18}$	$2.93E^{-17}$
Women	Mean of differences	2.54	2.72	5.26
	SD	1.97	1.86	2.17
	P	$2.35E^{-10}$	$8.06E^{-12}$	$1.33E^{-18}$

SE = standard error.
P < 0.01 was considered significant.

4. Discussion

The main finding of this preliminary investigation indicated that sexual dimorphism of the mandibular angle could not be detected in a young Lebanese population sample. It is not predictable to determine the gender of isolated skeletal elements of Lebanese origin using the value of the mandibular angle as a sole discrimination parameter within the limited study sample.

Numerous studies have shown differences between racial groups.[2,4,5] Hence, the measurements of one racial group could not be considered for others. This concept emphasized an infinite existed variety of facial patterns in a normal range of a particular racial group. This variety may explain the difficulties in implementing norms which have been successfully applied in other populations possibly attributed to ethnic differences.

The characteristics of cranio-dento-facial morphology among Chinese in Taiwan with different occlusions stated that regardless the class of occlusion or the stage of maturity, the cranio-dento-facial size of males is significantly larger than that of females. However, their cranio-dento-facial morphology is similar. The authors indicated that the sexual dimorphism of the cranio-dento-facial width dimensions is most pronounced in the zygoma, the mandibular angle and the condyles.[11] On the other hand, Biggerstaff had reported that the mandible exhibits several dimorphic traits that are clearer in women than in men leading to a greater mandibular angle in women than men.[13]

In view of the findings of the current study, the differences between the values of A1, A2 and A3 were previously reported.[20–23] In Forensic Odontology such differences were unable to identify the gender using the mandibular angle; the evaluation of the mandibular angle in the Anatolian populations showed that there were no significant differences between the right and left mandibular angles of the individuals but there was a significant difference at the left mandibular angle between sexes.[4] In contrast, the sex differences were noted in a previous study conducted by Kondo and Townsend in Australian Aborigines.[5]

This study demonstrated no significant difference of the mandibular angle in sex determination in a young Lebanese population. Further investigations with a larger sample size and a strongly established Lebanese background should be conducted to test the applicability of the mandibular angle sexual dimorphism.

5. Conflict of interest statement

None declared.

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None declared.

Ethical Approval

None declared.

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